Sensors and Materials, 3, 6 (1992) 325–334
MYU, Tokyo

S & M 0089

Thermoelectric Properties of Polysilicon Films Doped with Phosphorus and Boron

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(Received January 17, 1992; accepted March 27, 1992)

Key words: polysilicon film, thermoelectric properties, thermoelectric sensor

The thermoelectric properties of polysilicon films doped with boron or phosphorus are investigated within the temperature range of 80–400 K. The results are analyzed in the framework of the grain boundary trapping model and semiconductor transport theory. Correlations between electrical conductivity and Seebeck coefficient data are discussed.

1. Introduction

Polysilicon films are important constituents of the current integrated circuit (IC) technology.[1–3] Therefore, their structural and electrical properties have been investigated and reported by various researchers.[4–12] In view of the rather poor thermoelectric efficiency of polysilicon, the thrust of these investigations was not focused on the thermoelectric properties. On the other hand, new integrated sensors have been developed recently within the framework of standard IC technologies. A variety of thermoelectric sensors integrated on bulk silicon wafers, membranes, or beams have been realized,[13,14] which demonstrate the well-known advantages of on-chip signal conditioning and temperature compensation. New IC-compatible pressure sensors are based on polysilicon films.[15–21] Recently, thermoelectric thin-film sensors were developed using standard CMOS processes,[22–24] where polysilicon (normally used as a gate electrode) serves as one thermoelectric leg of the thermoelements or thermopiles.

For design, modelling, and optimization of such sensors, the knowledge of the